

## Chapter 2 – Sage-grouse and Sagebrush Ecology

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## **2 Sage-grouse and Sagebrush Ecology**

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An overall understanding of sage-grouse ecology and sagebrush ecology is important to those who wish to participate in sage-grouse conservation planning and design and implementation of effective conservation actions. The following chapter briefly summarizes key highlights of sage-grouse ecology in Section 2.1, and provides an overview of sagebrush ecology in Section 2.2. Both sections provide references to additional information that Local Working Group members, agency staff, and other individuals and organizations using this Plan may find valuable. Additional details regarding sage-grouse seasonal habitat characteristics can be found in Chapter 5, Section 5.3.2 and Appendix D.

### **2.1 Sage-grouse ecology**

A considerable wealth of information related to greater sage-grouse population biology and habitat use has been published over the past several decades. Idaho biologists have long played an important leadership role in research efforts to improve our understanding of this species. While questions continue to challenge biologists and wildlife managers, sage-grouse, nonetheless, are one of the most scrutinized and well-understood species of the sagebrush ecosystem. Space in this document does not permit an exhaustive review of the literature; however, Schroeder et al. (1999), Connelly et al. (2000b), Wambolt et al. (2002), Connelly et al. (2004), and Schroeder et al. (2004) offer up-to-date, detailed information on the ecology of greater sage-grouse. Additionally, Benedict et al. (2003) provides information on the genetics of greater sage-grouse. Crawford et al. (2004) provides a synthesis paper on the ecology and management of sage-grouse and sage-grouse habitat.

#### **2.1.1 Taxonomy and behavior overview**

Two species of sage-grouse occur in western North America. The greater sage-grouse is the focal species in this Plan. This grouse is a large upland game bird that was once widespread throughout sagebrush-dominated habitats of the western United States and Canada, and abundant in some areas. Adult males weigh 1.8-3.6 kg (4-8 pounds) and adult females 0.9-1.8 kg (2-4 pounds). This species currently occurs in ten western states and two provinces (Schroeder et al. 2004). Although the greater sage-grouse was divided into western and eastern subspecies (Aldrich 1946), recent genetic analysis has not supported this delineation (Benedict et al. 2003). The

Gunnison sage-grouse (*Centrocercus minimus*) inhabits portions of Colorado and southeastern Utah and is a smaller relative of the greater sage-grouse. The Gunnison species is currently classified by the USFWS as a candidate for threatened status and is being managed under separate conservation planning efforts.

During the spring (normally early March to mid-May), males gather on traditional breeding areas, called leks, for displaying and mating. Using elaborate plumage displays and inflatable air sacs that produce a loud “plopping” sound males attract females and protect their territory on the lek from other males. Females normally begin moving from winter to breeding areas from late February to early March, but actual lek attendance varies somewhat throughout the species range (Connelly et al. 2004). After breeding, females move away from the lek to establish nests. Evidence suggests that nest sites are selected independent of lek location (Wakkinen et al. 1992). In Idaho, hens nest an average of 3-5 km (2-3 mi) from their lek of capture but may move more than 18 km (11 mi) to nest (Connelly et al. 2004).

### **2.1.2 Migration**

Three types of seasonal movement patterns have been described for greater sage-grouse: (1) non-migratory; grouse do not make long distance movements (e.g., >10 km (6 mi) one way), (2) one-stage migratory; grouse move between two distinct seasonal ranges, and (3) two-stage migratory; grouse move among three distinct seasonal ranges (Connelly et al. 2000b). Many sage-grouse populations in Idaho are migratory. Some birds range up to 125 km (77.5 mi) with a home range of 2,764 km<sup>2</sup> (1,067 mi<sup>2</sup>) (Leonard et al. 2000). Most migratory movements tend to be slow and meandering (Dunn and Braun 1986a, Connelly et al. 1988), but relatively long-distance movements can occur over just a few days (Schroeder et al. 1999). In the late summer and early fall, migratory sage-grouse often congregate into flocks in preparation for movement to traditional wintering grounds. Despite large annual movements, greater sage-grouse show high fidelity to seasonal ranges (Schroeder et al. 1999). Female sage-grouse return to the same area to nest each year (Fischer et al. 1993) and some may nest within 200 m (656 ft) of their previous year’s nest (Lyon 2000).

### **2.1.3 Population biology**

Sage-grouse are long-lived for an upland game bird. Four- and five-year-old birds are not unusual and 60-80% of adult females commonly survive each year. Survival rates of adult males usually range from 50 to 60% (Connelly et al. 2004). Sex ratios for adult sage-grouse are skewed in favor of females (Connelly et al. 2004), and the

lower survival rate of males compared to females is the likely cause of this sex ratio. In contrast, most other upland game birds are characterized by populations with the majority of individuals under one year-of-age, and exhibit adult survival rates of about 30% each year.

Within 7 to 10 days after breeding the hen builds a nest. The peak of egg-laying and incubation varies from late March through mid-June depending on weather, elevation, and plant phenology (Schroeder et al. 1999). Nest bowls may be scratched or dug immediately before the first egg is laid although relatively few specifics are known. In Idaho, clutch sizes for greater sage-grouse average 6 to 7 eggs, relatively low for an upland game bird (Connelly et al. 1993, Apa 1998, Wik 2002). Incubation starts when the last egg is laid or one to two days after. The incubation period is 25 to 29 days (Schroeder et al. 1999). Adult female ( $\geq 2$  years old) sage-grouse nest about 80% of the time, while yearling females nest about 55% of the time. In Idaho, about 15% of sage-grouse hens that lose a nest will subsequently re-nest (Connelly et al. 1993, Wik 2002). In contrast, nearly all sharp-tailed grouse (*Tympanuchus phasianellus*) and ring-necked pheasant (*Phasianus colchicus*) nest each year and may attempt to re-nest up to four times if previous nests are destroyed. The greater sage-grouse has one of the lowest reproductive rates of any North American game bird, and its populations are not able to recover from low numbers as quickly as many other upland game bird species.

Drought may affect sage-grouse populations by reducing herbaceous cover at nests, and food quality/quantity for hens and chicks (Hanf et al. 1994, Fischer et al. 1996a). Relatively wet springs may result in increased production (Wallestad 1975, Autenrieth 1981). However heavy rainfall during egg-laying or unseasonably cold temperatures with precipitation during hatching may decrease production (Wallestad 1975).

### **2.1.4 Habitat characteristics**

Greater sage-grouse are dependent on large areas of sagebrush/grassland habitats with 15-25% sagebrush canopy cover for breeding habitat and 10-30% canopy cover for winter habitat. A healthy perennial grass and forb understory is also an important component of nesting and brood-rearing habitat. The availability of a diversity of forbs rich in calcium, phosphorus and protein are also important to pre-laying hens (Connelly et al. 2000b). On an annual basis migratory sage-grouse populations may occupy an area that exceeds 2,700 km<sup>2</sup> (1,042 square miles) (Hulet 1983, Leonard et al. 2000). During winter, Robertson (1991) reported that migratory sage-grouse in southeastern Idaho made mean daily movements of 752 meters (2,467 ft) and occupied an area greater than 140 km<sup>2</sup> (54 square miles). For a non-migratory population in Montana, Wallestad (1975) reported that winter home range size ranged

from 11 to 31 km<sup>2</sup> (4.2 to 12 square miles). During summer, migratory sage-grouse in Idaho occupied home ranges of 3 to 7 km<sup>2</sup> (1.2 to 2.7 square miles) (Connelly and Markham 1983, Gates 1983).

Most sage-grouse select nest sites under sagebrush (Patterson 1952, Connelly et al. 1991). In general, sagebrush and perennial understory grasses and forb cover are key components of sage-grouse nesting and early brood-rearing habitat. If sagebrush is eliminated from a large area, it will not support sage-grouse populations because nesting success and/or juvenile survival will be reduced. Recent research has shown that perennial herbaceous cover is particularly important for sage-grouse reproduction (Barnett and Crawford 1994, Gregg et al. 1994). Benefits provided by herbaceous understory include increased access to insects and forbs by hens before breeding and by chicks. Herbaceous understory also provides cover to hide nests, eggs and chicks from predators.

Insects are a key component of sage-grouse early brood-rearing habitat. A high protein diet of insects is necessary for all young upland game birds during the first month of life. Sage-grouse chick survival is lower if insects are unavailable (Johnson and Boyce 1990), probably because of starvation and increased vulnerability to predation while searching for scarce food. The most productive sage-grouse brood-rearing habitat includes a perennial grass and forb canopy cover of  $\geq 15\%$ , as well as a 10-25% canopy cover of sagebrush (Connelly et al. 2000b). Late summer (mid-July to September) brood-rearing habitat may include agricultural fields, meadows, and riparian areas adjacent to big sagebrush communities. In years of above average summer precipitation, late summer brood-rearing habitat may overlap early summer brood-rearing habitat.

During winter, sage-grouse feed almost exclusively on sagebrush leaves (Patterson 1952, Wallestad et al. 1975). If adequate sagebrush is available for winter food and cover, sage-grouse are seldom impacted by severe winter weather, and sage-grouse gain weight during winter (Beck and Braun 1978). However, loss of sagebrush on winter ranges may severely impact sage-grouse populations (Beck 1977).

In general, sage-grouse populations decline when large areas of sagebrush/grassland habitat are altered or fragmented. Reducing or eliminating sagebrush canopy cover, seeding-introduced grass species, conversion to agriculture, fire, suburban development, invasion by annual grasses, and management that results in a significant reduction of the perennial grass/forb understory have all been responsible for sage-grouse habitat loss or degradation. Additionally, power lines, roads and highways, reservoirs, and other developments commonly cause fragmentation of sagebrush ecosystems (Connelly et al. 2004).



Connelly et al. (2000b) summarized habitat characteristics that were representative of productive sage-grouse habitat (Appendix D). The authors noted that vegetative characteristics generally associated with productive habitats might not occur in some areas. In these cases, the authors suggested that local biologists and range ecologists develop height and cover requirements that are reasonable and ecologically defensible. Additionally, Connelly et al. (2000b) indicated that because of gaps in our knowledge and regional variation in habitats, the judgment of local biologists/ecologists and quantitative data from population and habitat monitoring are necessary to implement management guidelines correctly. They urged agencies to use an adaptive management approach (MacNab 1983, Gratson et al. 1993) using monitoring and evaluation to assess the success of implementing the guidelines to manage sage-grouse populations. They also recommended that local and regional conservation plans should summarize conditions needed to maintain healthy sage-grouse populations and stated that local differences in conditions should be considered in these plans.

## 2.2 Sagebrush ecology

Sagebrush species and subspecies are distributed along complex and interacting gradients of elevation, precipitation, temperature, aspect, slope, and soil depth, texture, and salinity. The woody sagebrushes provide critical habitat components and are a major food source for sage-grouse (Braun et al. 1977, Drut et al. 1994b, Connelly et al. 2000b). Sage-grouse are dependant on the full diversity of sagebrush systems for their annual food and cover. This relationship is reflected by the close alignment of their distribution with the range of sagebrush, particularly big sagebrush (*Artemisia. tridentata*) and silver sagebrush (*A. cana*) communities. This relationship is perhaps tightest in the late autumn, winter, and early spring when sage-grouse are dependent on sagebrush plants themselves for both food and cover. In much of the west historically heavy livestock use has reduced forb, perennial grass, and biological soil crust components, allowing sagebrush and exotic annuals to become dense (Billings 1994, Rosentreter and Eldridge 2002).

Woody sagebrush species have been of major interest and concern to land managers for many years. An understanding of the types of sagebrush that sage-grouse utilize for food and cover, and where these sagebrush types occur on the landscape is essential in conservation planning for the species. Species and subspecies of sagebrush have moderate to vastly different palatability and structural characteristics which influence their particular values for wildlife (Sheehy and Winward 1981). Winward and Tisdale (1977) state that the separation of big sagebrush into subspecies assists in the recognition of habitat types, production potential, chemical content, and palatability preference.

The ability to recognize the various sagebrush communities is important because they are indicators of a given local ecosystem composed of specific vegetation types, soil depth, climate, topography, and wildlife species. Fortunately, sagebrush communities are generally repetitive and easily identifiable (Beetle 1960, West 1988). Winward (2004) provides a concise reference for many sagebrush species and subspecies, with excellent color photographs. However, initial and periodic refresher training, including field-trips, on the identification and ecology of the various sagebrush species and subspecies is strongly recommended for members of LWGs, including agency specialists. Differences in some sagebrush species and subspecies can be subtle to the untrained eye. To that end, sagebrush identification and ecology field trips can be arranged throughout Idaho. Interested LWGs or agency specialists should forward requests for such training to the Idaho Sage-grouse Advisory Committee coordinator.

While selected aspects of sagebrush identification and ecology are presented below, an exhaustive treatment of the subject is beyond the scope of this chapter. For additional detail, see the following references: Anderson and Holte (1981), Anderson and Inouye (2001), Hironaka et al. (1983), McArthur and Welch (1986), Miller et al. (1994), Miller and Eddleman (2001), Passey et al. (1982), Tisdale et al. (1969), Tisdale and Hironaka (1981), Schlatterer (1972), Welch (2005), Welch and Criddle (2003), West and Young (2000). Complete citations are located in the Literature Cited section of this Plan. Additional detailed information on sagebrush (and other plant species), and fire ecology/ management is readily available at the following websites:

- Fire Effects Information System: <http://www.fs.fed.us/database/feis/>
- Landfire website: <http://www.landfire.gov/modelswestern.html>

### **2.2.1 Palatability of sagebrush**

An understanding of the relative palatability of sagebrush species and subspecies is potentially useful in delineating seasonal habitats or to aid in the selection of sagebrush species/subspecies for restoration purposes. However, the overall *availability* of sagebrush to meet the various seasonal cover and foraging needs of sage-grouse at local and broader scales is probably of greater importance in conservation planning. For example, in lower elevation sage-grouse wintering or nesting areas, the presence and availability of Wyoming big sagebrush on the appropriate ecological site is desirable from a conservation perspective, even though

other sagebrush subspecies may be more palatable. With that in mind, the following two paragraphs, paraphrased from Rosentreter (2005), provide a concise overview of factors affecting the palatability of sagebrush.

It is well documented that some sagebrush species are more palatable to wildlife due to their specific chemical content (Morris et al. 1976, Sheehy and Winward 1981, Welch et al. 1983, Wambolt 2001). The difference in palatability is based on plant chemistry and the amount of volatile chemicals present in sagebrush leaf glands (Kelsey et al. 1984, Striby et al. 1987). Leaf glands vary seasonally in the amount and concentration of chemicals they contain, with concentrations highest in spring and lowest in winter (Cedarleaf et al. 1983, Kelsey et al. 1984). This is due to the semi-evergreen nature of sagebrush and the presence of persistent leaves produced in the spring, the glands of which are full of volatile chemicals that discourage herbivory. With release of volatile chemicals, the sagebrush leaf becomes more digestible. This process has been demonstrated through in vitro (laboratory) digestibility studies of sagebrush leaves and alfalfa with the addition of sagebrush-specific volatile compounds (Striby et al. 1987, Wambolt et al. 1991). Thus, while some sagebrush species' high crude protein content encourages herbivory, others contain chemicals such as volatiles, methacrolein, acetone, and 1-8 cineole that discourage feeding (Kelsey et al. 1982, Wambolt et al. 1991, Wambolt 1996).

Most sagebrush palatability information is not specific to sage-grouse, but instead is based on observations of other wildlife species and digestibility experiments by Kelsey, Wambolt, and others (Schwartz et al. 1980, Sheehy and Winward 1981, Kelsey et al. 1982, Yabann et al. 1987, Wambolt et al. 1991, Barnett and Crawford 1994, Wambolt 2001). The palatability of sagebrush and other plants varies depending on the adaptations of the individual animal or population of animals feeding on it. In addition to the chemical content of food, learned behaviors may also dictate the food choices animals make.

### **2.2.2 Types of sagebrush**

Three major structural types of sagebrush plants in Idaho are (1) tall sagebrush, (2) dwarf sagebrush, and (3) sub-shrub sagebrush (Rosentreter 2005). These broad sagebrush types are used by sage-grouse for food, escape cover, and/or nesting habitat. Tall sagebrush types provide the best escape cover and nesting habitat for sage-grouse. Dwarf sagebrushes may be more palatable (Rosentreter 2005) and are critical food sources in the winter for sage-grouse but do not provide good escape cover or nesting habitat due to their lower stature. Subshrub sagebrushes are also low in stature and are of only moderate to low palatability (Rosentreter 2005).

### 2.2.2.1 Tall sagebrush types

Tall sagebrush types most common in Idaho are Wyoming big sagebrush, mountain big sagebrush, basin big sagebrush, and xeric big sagebrush. Additional species include threetip sagebrush and silver sagebrush.

**Wyoming Big Sagebrush** (*Artemisia tridentata* ssp. *wyomingensis*): Wyoming big sagebrush is a medium-sized shrub from 1-3 ft tall; it branches from the base, and has an uneven crown (Rosentreter 2005). This subspecies occurs in foothills, undulating terraces, slopes, and plateaus, as well as basins and valley bottoms. Precipitation averages 7-12 inches (McArthur 2000). In Idaho, Wyoming big sagebrush occurs between 2,500 and 6,500 ft in elevation (Johnson 1999). Wyoming big sagebrush sites have fewer understory species compared to other big sagebrush subspecies (Howard 1999).

Many researchers believe fire historically played an important role as a disturbance factor in Wyoming big sagebrush (<http://www.landfire.gov>), though Miller and Eddleman (2001) suggest burn patterns in this type were patchy due to limited and discontinuous fuels. Other disturbance factors include insects such as the *Aroga* moth (see Welch 2005 for additional information), drought/wet cycles, rodents and lagomorphs, climate change, and grazing (<http://www.landfire.gov>). Fire return intervals reported in the literature vary (e.g., 25-100+ years, West 2000; 50-100 years Wright and Bailey 1982). Current scientific opinion is about 100 years (<http://www.landfire.gov>). However, Baker (2006) suggests fire rotations in Wyoming big sagebrush may be considerably longer, at 100-240 years. Fire return intervals have been shortened to 2-4 years in some areas of the Snake River Plain, due to cheatgrass (Whisenant 1990). Recovery of Wyoming big sagebrush post-fire can be slow, relative to other big sagebrush subspecies due to the relatively drier sites it occupies (Johnson 1999).

Wyoming big sagebrush is generally palatable, though its palatability is highly variable (Rosentreter 2005). Sage-grouse use Wyoming big sagebrush sites for wintering, pre-laying, nesting and brood-rearing habitat (Crawford et al. 2004).

Many Wyoming big sagebrush sites have been severely degraded, and converted to exotic annual grasslands (Hilty et al. 2003). Non-degraded, lightly grazed Wyoming big sagebrush sites have a high percentage of biological soil crusts and low percentage of cheatgrass (*Bromus tectorum*) cover (Rosentreter 1986, Kaltenecker et al. 1999, Rosentreter and Eldridge 2002). Due to their susceptibility to invasion and domination by cheatgrass and other exotic annuals, and slow recovery, use of fire to manage these sites must be approached with caution. Wyoming big sagebrush sites should be managed for the restoration or retention of the biological soil crust

component where possible, most critically in the lower precipitation zones (Rosentreter 2005). Late fall, winter, and early spring are the most appropriate seasons of use for livestock in this low-elevation vegetation type (Rosentreter 2005). Four to six weeks of moist soil conditions in late spring facilitates growth of biological soil crusts disturbed by trampling (Mommott et al. 1998, Rosentreter and Eldridge 2002).

**Mountain Big Sagebrush** (*Artemisia tridentata* ssp. *vaseyana*): Mountain big sagebrush generally grows above 5,000 ft (Rosentreter 2005). Mean annual precipitation is 14-22 inches, but can range from 10-30 inches (Mueggler and Stewart 1980, Tart 1996). It typically occurs on moist, productive, rolling upland sites. Soils are typically deep and have well developed dark organic surface horizons (Hironaka et al. 1983, Tart 1996). This sagebrush subspecies branches from the base, grows to 3 ft tall, and typically has an even, flat-topped crown (Tisdale and Hironaka 1981, Rosentreter 2005).

Mean fire return intervals have been debated (Welch and Criddle 2003). Mountain big sagebrush communities were historically subject to stand replacing fires with a mean return interval ranging from 10 years at the Ponderosa pine ecotone, to 40+ years at the Wyoming big sagebrush ecotone, and up to 80 years in areas with a higher proportion of low sagebrush in the landscape (Crawford et al. 2004, Johnson 2000, Miller et al. 1994, Burkhardt and Tisdale 1969, Burkhardt and Tisdale 1976, Houston 1973, Miller and Rose 1995, Miller et al. 2000). However Baker (2006) suggests fire rotations were longer, ranging from 70-200 years.

Recovery rates for mountain big sagebrush vary, typically reaching 5% canopy cover in 8-14 years; and can reach 25% canopy in 25 years (range 9-70 years) (Winward 1991, Pedersen et al. 2003).

Mountain big sagebrush is highly palatable to wildlife; however, limited access in the winter and the chemical content in spring and summer may discourage herbivory (Kelsey and Shafizadeh 1978, Kelsey et al. 1984). Mountain big sagebrush sites generally provide winter, nesting and brood-rearing habitat for sage-grouse (Crawford et al. 2004). Mountain big sagebrush can be a major food source for sage-grouse in the winter months (Rosentreter 2005).

Mountain big sagebrush has a greater potential to increase its density, as compared to other sagebrush taxa, due to the higher moisture associated with its sites and its general ecology (Rosentreter 2005). Stands can become so dense that they may exceed sagebrush cover conditions needed for productive sage-grouse nesting or brood habitat described in the WAFWA Guidelines. At the ecotone with conifer forests or pinyon-juniper communities, mountain big sagebrush sites are readily invaded by these species in the absence of fire or other disturbance (Miller and Rose

1999). Mechanical control, burning, or other treatments may be necessary in some areas to restore desirable plant composition and structure to meet wildlife habitat objectives.

**Basin Big Sagebrush** (*Artemisia tridentata* ssp. *tridentata*): Basin big sagebrush is found between about 3,000-6,000 feet; annual precipitation ranges from 8 to 14 inches (see <http://www.landfire.gov>). It commonly grows on deep, fertile, well-drained soils in valley bottoms, lower foothill areas or in areas adjacent to drainages (Tirmenstein 1999). Because it tends to grow on productive sites, many areas once dominated by this subspecies are now farmland (Young and Evans 1981, Pechanec et al. 1954 cited in Tirmenstein 1999).

Basin big sagebrush tends to be single-trunked, or tree-like or Y-shaped in appearance and the crown is uneven (Rosentreter 2005). It normally reaches 3-10 feet in height. Areas dominated by Wyoming big sagebrush frequently have basin big sagebrush occurring along road ditches due to the extra moisture runoff from roads. Consequently, basin big sagebrush seed is often inadvertently harvested along with the seed of Wyoming big sagebrush (Rosentreter 2005).

In comparison with mountain and Wyoming big sagebrush, basin big sagebrush is least preferred by sage-grouse (Welch 1991 cited in Tirmenstein 1999). Relative palatability of basin big sagebrush appears to be among the lowest of 23 species or subspecies of sagebrush evaluated (Rosentreter 2005). Basin big sagebrush leaves have rarely been identified in sage-grouse scats (Rosentreter 2001, unpublished data; Vasquez 2002). Because of the treelike growth form, it is likely that mature stands of basin big sagebrush may provide only marginal cover value to nesting sage-grouse. Younger stands with lower growing plants may provide suitable cover for nesting and broods, but information in the literature is lacking. The currently limited extent of basin big sagebrush on the Idaho landscape also suggests that this subspecies is of less significance overall than other big sagebrush subspecies, such as Wyoming and mountain big sagebrush.

Fire-return intervals for basin big sagebrush types are estimated to average approximately 60 years, ranging from 10-150 years (see <http://www.landfire.gov>), and are intermediate between those of mountain and Wyoming big sagebrush (Sapsis 1990 cited in Tirmenstein 1999).

**Xeric or Foothill Big Sagebrush** (*Artemisia tridentata* ssp. *xericensis*): Xeric big sagebrush is a tall shrub (>3 ft) with Y-shaped architecture similar to that of basin big sagebrush (Rosentreter 2005). Its chemistry, leaf shape, and palatability are most similar to mountain big sagebrush (Rosentreter 2005). This Idaho subspecies is restricted to heavy clay-loam and drier, xeric soils, than mountain big sagebrush, and occurs from approximately 2,500-5,400 ft (Roesntreter and Kelsey 1991, Rosentreter



2005). Average annual precipitation ranges from 12-22 inches (Rosentreter and Kelsey 1991). It appears to have been initially derived through hybridization between basin big sagebrush and mountain big sagebrush (Rosentreter and Kelsey 1991). Its distribution is limited to west-central Idaho, predominantly Washington County, and portions of adjoining counties (Rosentreter and Kelsey 1991). Xeric big sagebrush is heavily utilized in winter by mule deer and, based on its chemistry (high crude protein) (Rosentreter and Kelsey 1991), is likely preferred by sage-grouse (Rosentreter 2005). Information on fire history is currently unavailable.

**Tall Threetip Sagebrush** (*Artemisia tripartita* ssp. *tripartita*): Tall threetip sagebrush is a fairly tall, erect shrub. It ranges from 16-32 inches tall (Winward 2004) though can reach up to 4-6 ft (Rosentreter 2005). A second subspecies, Wyoming threetip sagebrush (*Artemisia tridentata* ssp. *rupicola*), apparently does not occur in Idaho, though occurs in Wyoming, Montana, and southern Oregon (Tirmenstein 1999, Winward 2004). In the Intermountain Region, tall threetip is found between approximately 3,400 to 7,100 ft elevation (Tirmenstein 1999). Tall threetip sagebrush grows on deep, well-drained soils, often mixed with basin or mountain big sagebrush, and can also dominate playa situations (Rosentreter 2005). Tall threetip will seldom layer<sup>1</sup> without disturbance but will vigorously stump-sprout and layer after burning (Rosentreter 2005). Because of this, it can increase in density and acreage when disturbed (Winward 2004), and can form nearly pure stands postfire (Tirmenstein 1999). In Idaho, tall threetip is common in parts of the Upper Snake River Plain. Information on fire return intervals is not readily available.

In southern Idaho, sage-grouse may include small amounts of threetip sagebrush leaves in their diets but it is not preferred browse for most wild ungulates (Tirmenstein 1999). It provides food, cover, and nesting habitat for sage-grouse (Gray 1967, Klebenow 1969, Hironaka et al. 1983, Sveum et al. 1998a).

**Silver Sagebrush** (*Artemisia cana*): Two subspecies of silver sagebrush occur in Idaho; mountain (*A. cana* ssp. *viscidula*) and Bolander (*A. cana* ssp. *bolanderi*) (Hironaka et al. 1983, Rosentreter 2005), and they are found in distinctly different habitats.

Mountain silver sagebrush ranges from 0.3 to 1 ft in height and occurs from 6,000-8,000 ft in Idaho (Schlatterer 1972). It occurs in mountain meadows, stream terraces and stringers along stream courses, terraces, or areas of heavy winter snowpack (Schlatterer 1972, Hironaka et al. 1983, Howard 2002, Rosentreter 2005.). Mountain silver sagebrush sites are very productive, with a diversity of forbs, grasses and other shrubs (Howard 2002, Winward 2004). Where these sites occur within the elevational range of sage-grouse, they provide forage and cover for sage-grouse

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<sup>1</sup> To form roots where a stem or branch comes in contact with the ground.

adults and chicks (Winward 2004). Rosentreter (2005) ranked mountain silver sagebrush as highly palatable to sage-grouse. Mountain silver sagebrush is locally dominant on mountain grassland clay soils of central and eastern Idaho, where it forms the Camas Prairie association with common camas (*Camassia quamash*) (Rosentreter 1992 cited in Howard 2002).

Silver sagebrush resprouts strongly after being top-killed by fire (Britton 1979, Cronquist et al. 1994, Wright and Bailey 1982, and Wright et al. 1979). Mean fire return intervals in mountain silver sagebrush range from 3 to 45+ years (Arno 1980, Arno 2000, Heyerdahl et al. 1994). Houston (1973) estimated that on the Snake River Plain of Idaho, fires probably cycled about every 25 years in the wetter areas favored by mountain silver sagebrush.

Bolander silver sagebrush is generally less than 3 ft in height (Howard 2002) and most commonly occurs within internally drained basins (playas) (Hironaka et al. 1983, Rosentreter 2005). Rosentreter (2005) ranked it as moderately palatable to sage-grouse. Fire history studies in Bolander silver sagebrush communities are apparently lacking (Howard 2002).

#### 2.2.2.2 Dwarf sagebrush types

Dwarf sagebrush types most common in Idaho include early, black, and low sagebrush, and budsage. Chicken sage, while not an *Artemisia*, is also discussed briefly, due to its occurrence in Idaho.

**Early (alkali) Sagebrush** (*Artemisia longiloba*): Some references refer to early sagebrush as a variety of low sagebrush, or *Artemisia arbuscula*, (for example, see <http://www.landfire.gov>). However other authors consider it a separate species (Beetle 1960, Winward 2004, Rosentreter 2005). The color and morphology of *A. arbuscula* and *A. longiloba* are very similar (Winward 2004). Early sagebrush grows on shallow, ephemerally flooded soils, often with a claypan or skeletal rock layer near the surface (Robertson et al. 1966). It is frequently found in low-drainage areas of flats, plateaus, or tables (Rosentreter 2005). Early sagebrush is a prolific seed-producer and could be used for restoration in appropriate, shallow soil sites (Beetle and Johnson 1982, Monson and Shaw 1986). It “layers” and can re-sprout after cool fires (Rosentreter 2005). Rosentreter (2005) rated early sagebrush as highly palatable to sage-grouse and noted that some of the largest leks in Idaho are in areas dominated by this species. Early sagebrush flowers very early in the summer, in contrast to other low-statured species. Early sagebrush has also been confused with low-growing Wyoming big sagebrush because of its broadly cuneate (wedge-shaped) three-lobed leaves and with low sagebrush because of its dwarf size (Rosentreter 2005). It is



palatable to sheep and, historically, stands were commonly used as lambing areas (Beetle and Johnson 1982). Early sagebrush has also been referred to as “alkali sage”.

Mean Fire Return Intervals in early sagebrush sites are similar to low sagebrush and are estimated by some sources to be 125 years (<http://www.landfire.gov>). Intervals may range from 40 years (Steinberg 2002) to more than 400 years (Baker, 2006) and are probably strongly related to the fire regimes of surrounding vegetation communities (<http://www.landfire.gov>).

**Black Sagebrush** (*Artemisia nova*): Black sagebrush is a low-growing (4-12 inches high), multi-branched shrub (Winward 2004). It can commonly be identified by its persistent brownish colored flower stalks (Winward 2004, Rosentreter 2005). This species grows well on very shallow, stony soils, often on windswept slopes and ridges at mid- to high elevations (Behan and Welch 1985). It prefers calcareous or well-decomposed granitic soils that seem to mimic calcareous sites due to weathering of calcium feldspars. It occurs most abundantly from 4,900 to 7,000 ft in elevation where annual precipitation averages between 7 to 18 inches (McMurray 1986).

There appear to be at least two chemical races of black sagebrush in the West (McArthur and Plummer 1978; Kelsey 2002, personal communication). One race, with grayer leaves, is highly palatable while the greener-leaved race has low palatability (McArthur and Plummer 1978). This latter form does not fluoresce under UV-light; the former does, and was rated as highly palatable for sage-grouse (Rosentreter 2005). Black and low sagebrush communities can provide important winter, pre-laying and brood-rearing habitat for sage-grouse (Crawford et al. 2004). Most black sagebrush populations have leaf glands visible with a 10x hand lens (Kelsey and Shafizadeh 1980). Resin from these glands causes a stickiness when leaves are crushed (Winward 2004).

Mean fire return intervals for mixed severity fires in black sagebrush are estimated at 100-140 years, and 200-240 years for stand-replacing events (<http://www.landfire.gov>).

**Low Sagebrush** (*Artemisia arbuscula*): Low sagebrush is a low-growing shrub 8-16 inches in height (Winward 2004). It grows on shallow soils with a restrictive layer of bedrock or clay pan (Rosentreter 2004). Annual precipitation ranges from 7 to 18 inches (Stevens 1983), but usually exceeds 12 inches (Rosentreter 2005). In Idaho, low sagebrush grows at approximately 6,000-9,800 ft (Schlatterer 1972). Soil parent material is non-calcareous (Rosentreter 2005). Black, early, Bigelow, Lahontan, and chicken sagebrush are often misidentified as low sagebrush (Rosentreter 2005). Low and black sagebrush communities can provide important winter, pre-laying and brood-rearing habitat for sage-grouse (Crawford et al. 2004). Low sagebrush is

readily consumed by sage-grouse (Klebenow 1973, Robertson 1986). Rosentreter (2005) rated low sagebrush as one of the most palatable sagebrushes for sage-grouse.

There is disagreement about fire frequency in low sagebrush communities. Estimates of mean fire return intervals range from 40 years (Steinberg 2002) to more than 400 years (Baker, 2006), and are probably strongly related to the fire regimes of surrounding vegetation (<http://www.landfire.gov>).

**Budsage** (*Artemisia spinescens* or *Picrothamnus desertorum*): Budsage grows on shallow, often saline soils at lower elevations and is frequently mixed with salt desert shrub vegetation (McWilliams 2003, Rosentreter 2005). It has spiny-tipped, thorn-like branches (Winward 2004), and reaches 4-10 inches in height (Institute for Land Rehabilitation 1979). It has palmately divided leaves that are deciduous. Budsage is considered to have low cover value for upland game birds (McWilliams 2003). Palatability for sage-grouse appears moderate, however its role with respect to sage-grouse use in Idaho is likely minor (Rosentreter 2005). Budsage communities rarely burn (McWilliams 2003). Specific information on fire regimes for bud sagebrush is not available, however they may be related to fire regimes of surrounding vegetation (McWilliams 2003).

**Chicken Sage** (*Tanacetum nuttallii*): Chicken sage grows on windswept benches and large flat areas with very shallow, calcareous gravels (Rosentreter 2005). It is woody with three-lobed leaves and a low (e.g. 4 inches tall) spreading growth form. It may be similar in appearance to a diminutive low sagebrush, hence its description here, but has smaller leaves (Rosentreter 2005). Sage-grouse can be found where this species is common, but use by sage-grouse is unknown (Rosentreter 2005).

### 2.2.2.3 Sub-shrub sagebrush types

The primary sub-shrub sagebrush types in Idaho include fringed sage and birdsfoot sage. In Idaho, fringed sagebrush is especially common in limestone-influenced valleys in the Challis and Salmon areas (R. Rosentreter, Botanist, BLM Idaho State Office, personal communication).

**Fringed Sagebrush** (*Artemisia rigida*): Fringed sagebrush is a small sub-shrub, woody only at the base. It occurs in a variety of soil types and depths but prefers shallow soils with “frigid” soil temperatures (Morris et al. 1976). Some sites are windswept and are readily available to wildlife in the winter. Studies in Montana (Peterson 1970, Wallestad et al. 1975) reported consumption of fringed sagebrush by sage-grouse, including juveniles. In Colorado’s Gunnison Basin, [Gunnison] sage-grouse have been observed feeding on fringed sage seedlings (Rosentreter 2005 citing J. Young, personal communication, Western State College, CO). Fringed

sagebrush is rated as moderately palatable (Rosentreter 2005) and may be an important sage-grouse food seasonally in parts of Idaho, especially in mid-elevation sites and upward (R. Rosentreter, Idaho BLM state office, personal communication). There is no specific information in the literature concerning fire regimes for fringed sagebrush (McWilliams 2003).

**Birdsfoot Sagebrush** (*Artemisia pedatifida*): Birdsfoot sagebrush is found in sagebrush-grass and saltbush (*Atriplex* spp.) (Goodrich and Neese 1986); it commonly occurs on alkaline soils (Morris et al. 1976). It is found from 5,200 to 5,900 ft on clay soils (Winward 2004). Information on fire regimes is not documented (Tirmenstein 1987). Rosentreter (2005) rated palatability to sage-grouse as low.